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A PLANTER-SPRAYER FOR PRECISION PLACEMENT OF SUBSURFACE BANDS OF HERBICIDES IN COTTON ROWS

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In the effort to develop more effective weed control techniques in cotton, a combination planter and sprayer assembly was designed and constructed for planting cotton and applying subsurface herbicide simultaneously.[2/] Precise control of the herbicide and crop seed is a primary feature of this equipment. Early evaluation tests in nutsedge-infested areas demonstrated that this equipment was highly effective in the precision placement of herbicides in soils.

Precision placement of agricultural chemicals in the seedbed has usually involved fertilizers. However, it has long been recognized that certain herbicides become more active after incorporation in the soil. In fact, a patent (8)[3/] for a subsurface herbicide applicator was granted in 1916. Today, experimental work with granules (1, 6) and liquids is underway in many locations. In some investigations the chemicals are applied on the soil and then mixed in with power-driven ground-working equipment (2, 5). In other investigations modified sweeps are used to place chemicals in the soil (3, 10).

The practice of incorporating herbicides in the soil and planting simultaneously has been used in other areas (2, 4, 11). Research in Mississippi and California with EPTC (ethyl N,N-di-n-propylthiolcarbamate) led to the development of an applicator for use in bedded land (2, 9, 13).

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3/ Underscored numbers in parentheses refer to Literature Cited, p.7.

Precision placement of chemical sprays in both the horizontal and vertical planes in relation to the crop seed has not been possible with currently available planters. However, in beginning this study it seemed that one of the most logical methods of obtaining a high degree of precision was to make the sprayer an integral part of the planter. The three most important aims in designing and constructing the planter-sprayer were--

1. Precision placement of the herbicide spray in both the horizontal and vertical planes in relation to the cottonseed. In the horizontal plane, the band could be either separated or solid in relation to the seed.

2. Easy adjustment of the planter and precise control of planting depth.

3. A planting unit that would leave the soil surface smooth and level for the application of postemergence herbicides. The current practice of smoothing with a heavy roller frequently compacts the soil over the planted seed more than desired.

Description of Planter-Sprayer

The planter was designed as a series of individual one-row units. Each unit attached directly to a pair of gang beams on a conventional parallel-acting rear-mounted cultivator. Attaching to a rear-mounted cultivator provides excellent flotation and reduces the overall cost of equipment required in the cotton production program as the rear-mounted cultivator is becoming popular equipment on farms in the high rainfall areas of the Cotton Belt.

The planter-sprayer assembly was designed for mounting in conjunction with the front-mounted seedbed preparation equipment shown in figure 1.

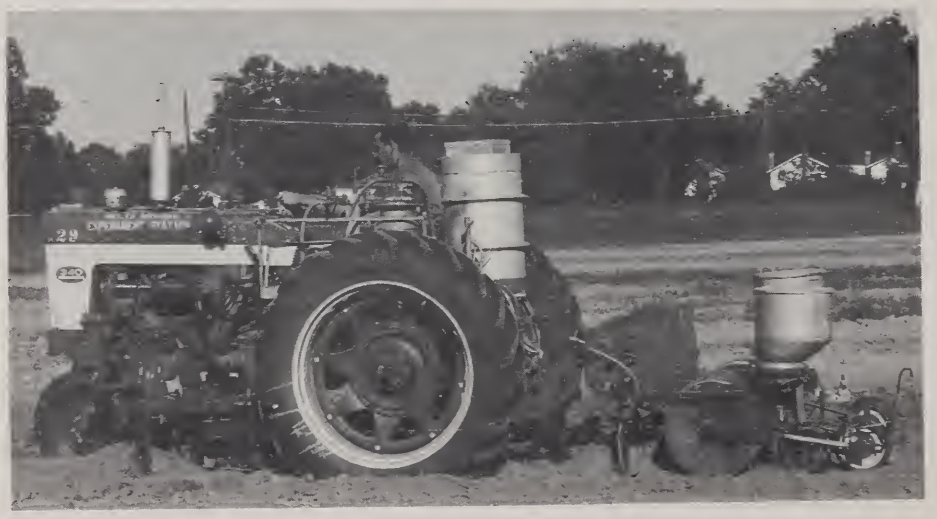
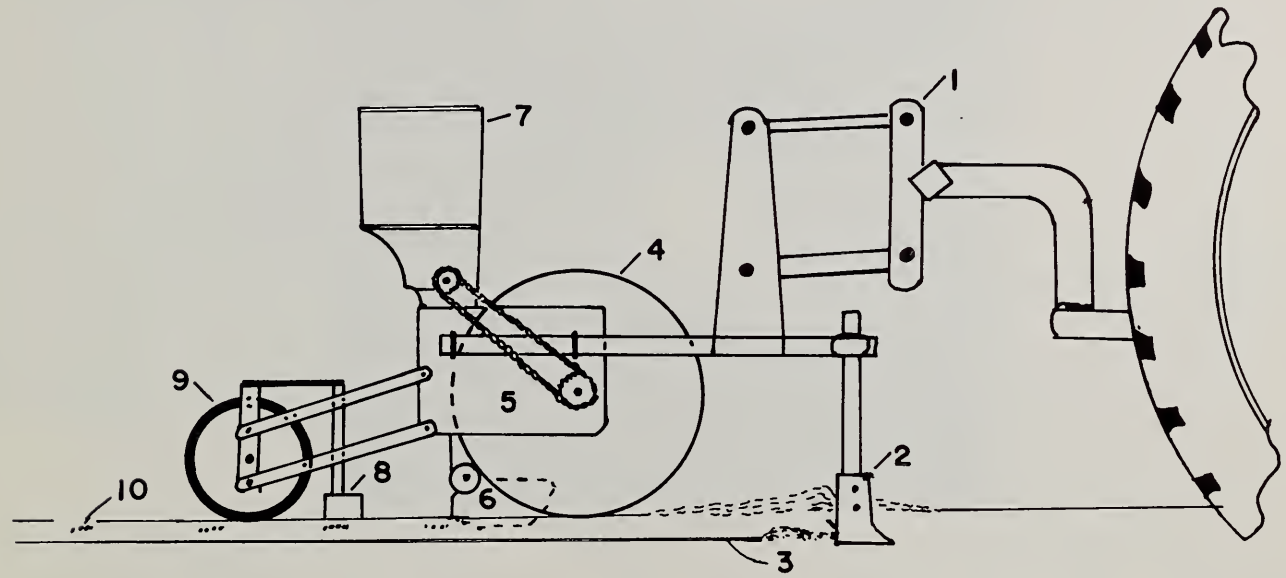


Figure 1. Planting and applying subsurface bands of herbicides on both sides of seed.

The front-end unit pulverizes the bed and flattens it to the finished height (12). In addition, tanks mounted over the rear axles are convenient for delivering liquid to the power-takeoff-driven pump.

The various components and sequence of the operations performed by this device are shown in figure 2. The subsurface applicator is attached to the



1. CULTIVATOR 2. SUBSURFACE APPLICATOR 3. SPRAY DEPOSIT 4. DRUMS 5. PLANTER ATTACHING PLATES. 6. OPENER WITH HILL DROP. 7. HOPPER 8. COVERERS 9. DUAL PRESS WHEELS 10. SEED.

Figure 2. Diagrammatic side view of combination planter and subsurface applicator showing components and sequence of operations.

two gang beams of the cultivator with sweep-standard clamps, and the planting unit is attached across the same beams behind the applicator. Between the applicator and the planter are two steel drums, each 20 inches in diameter and 7-1/2 inches wide. These drums are welded 5 inches apart on a single axle. The drums control depth of seed and placement of the chemical and drive the seed plate and hilldrop attachment by sprockets and roller chain (Fig. 3). Flexible scrapers of rubber belting are used to prevent a buildup of moist soil on the drums. The seed furrow opener projects forward at the rear of the drums into the space between the two drums.

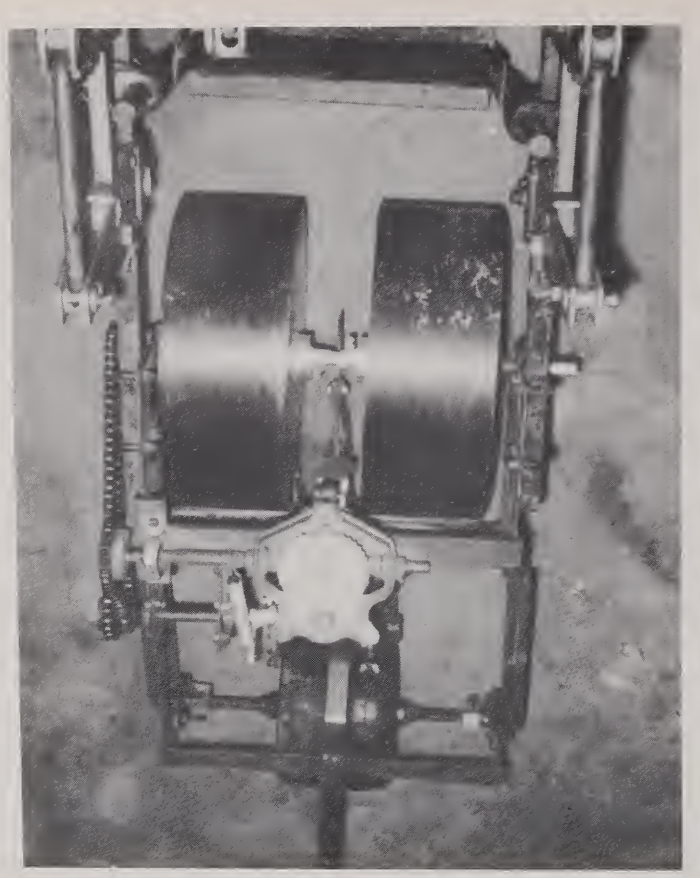


Figure 3. Top view of a single planting unit showing dual drums, planter drive mechanism and small dual press wheel.

Dual press wheels and disk coverers are attached with floating parallel linkage to the planter-attaching plates behind the drums. Figure 4 shows a rear view of the dual press wheels with the smooth bed in the foreground. Standard 4- x 12-inch gage wheels equipped with zero-pressure rubber tires were used in the assembly. The press wheels, in combination with the larger drums, flatten and smooth the seedbed for 10 inches on each side of the drill row to facilitate subsequent postemergence spraying.

In constructing the underground applicator, two orifices were modified to produce a fan spray with the shape of a right triangle.[4/] In addition, nozzle bodies were attached to 1/8-inch stainless steel pipe nipples. Set collars were then welded to the bottom side of the top section of the sub-

4/ Spraying Systems Company, 15,004 orifices modified by soldering one orifice in each tip to produce an off-center 7,504 orifice. Mention of a commercial company or product does not imply endorsement by the U.S. Department of Agriculture over others not mentioned.

Figure 4. Close view showing level seedbed behind combination planter and applicator. This bed will be nearly ideal for postemergence sprays.

surface applicator heads. This made the two nozzles adjustable so that the width of the unsprayed strip in the center of the applicator could be adjusted from 4 to 8 inches (Fig. 5). The spray was delivered through the orifices in a horizontal plane from the rear of the applicator. That is, the hypotenuse of the right triangle was to the rear of the applicator and the inside edge of the spray pattern was parallel to the centerline of the crop row.

Field Research

Field experiments in cotton included the application of EPTC at different rates and at depths of 1, 2, and 3 inches under the soil surface. Injury to the cotton was reduced by leaving untreated the central area 2, 3, and 4 inches on each side of the seed. The chemical was placed in bands 6, 7, and 8 inches wide on each shoulder of the row. The treatments included three bands centered 7, 6-1/2, and 6 inches, respectively, from the seed drill.

Figure 5. Rear view of subsurface applicator showing twin nozzle booms in vee of applicator blade. Nozzles are adjustable within set collars.

The chemical controlled weeds in a band about 3 inches wider than the treated width. Control of weeds in the central untreated area was accomplished with other herbicides to which cotton is more tolerant.

The underground application of herbicides in a split three-band arrangement is a new concept for weed control in cotton and has been designated "triband" weed control. A description of the method and results of field experiments is in press (7).

Equipment Performance and Evaluation

Overall performance of the combination underground applicator and planter was better than expected. The planting unit was extremely easy to adjust for depth control and a uniform depth of seeding was easy to maintain. Evidence of the precision placement of the chemical was noted by the uniformity of crop tolerance and weed control obtained following emergence of the cotton.

In evaluating compaction, bulk density measurements were made behind the experimental planter and behind a conventional planter equipped with 8 x 16 zero-pressure rubber-tired gage wheels. These measurements showed slightly less compaction behind the new planter. It was also determined that the shape of the seedbed was satisfactory for accurately applying herbicidal napthas.

Summary

A combination underground herbicide applicator and planter was designed, constructed, and evaluated in the field. Early results of this new "triband" method of chemical weed control in cotton were very promising. This new concept consists of placing a highly active, lowly selective herbicide in bands on each side of the crop plants. Weeds in the drill row are then controlled with more selective postemergence sprays. Important features of this development include (1) precision placement of the chemical in both horizontal and vertical planes in the seedbed, (2) ease of planter adjustment and precise control of planting depth, and (3) a finished bed adequate for postemergence operations without extra rolling.

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